

LOCAL CLIMATE ANALYSIS TOOL

LCAT DEMO



Nicole McGavock

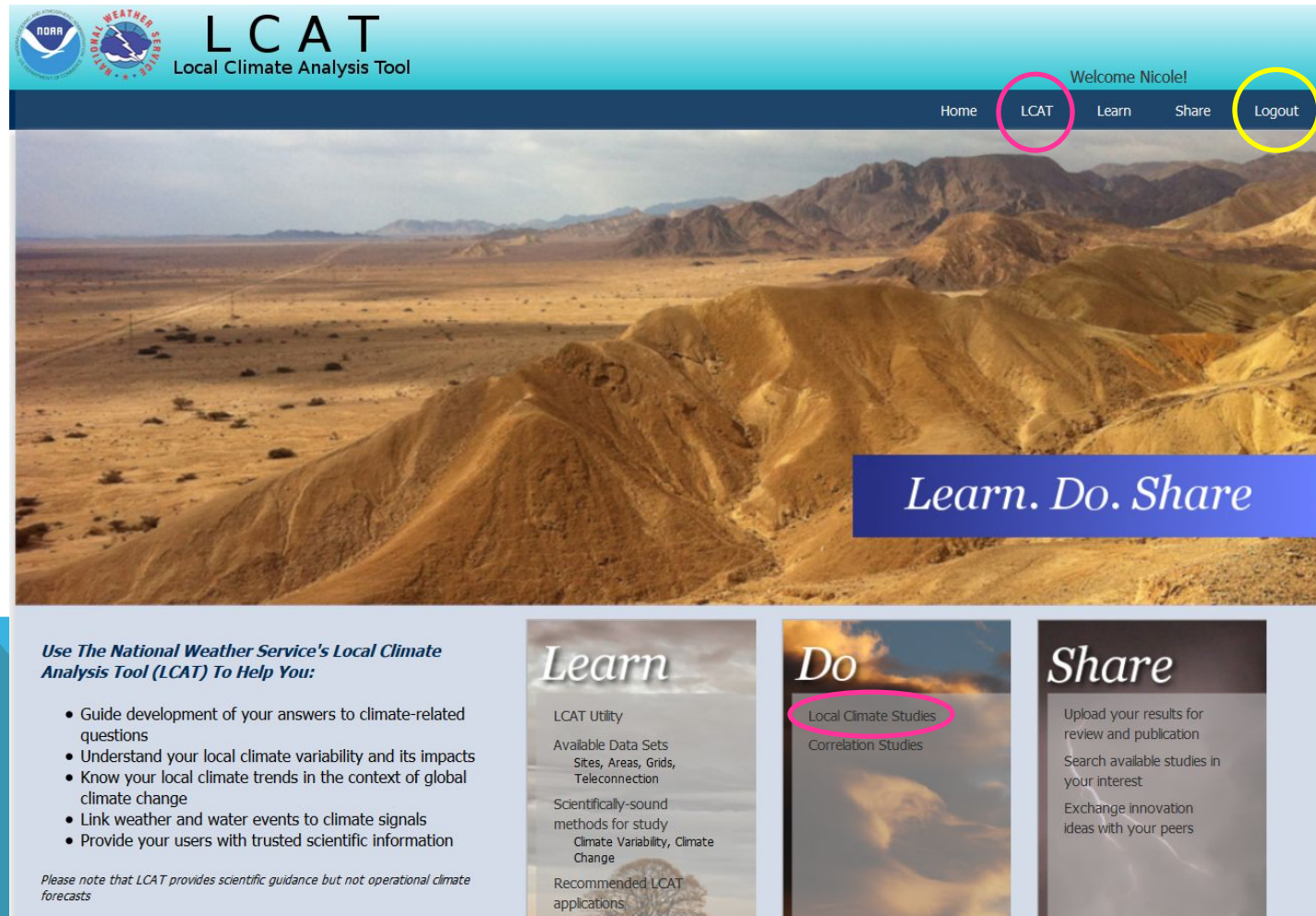
Service Hydrologist
Climate Services Focal Point
U.S. National Weather Service
Tulsa, OK

National Climate Services Meeting
May 9-12, 2016

GETTING STARTED

<http://nws.weather.gov/lcat/home>

Log in and navigate to the LCAT Local Climate Studies



The screenshot shows the LCAT (Local Climate Analysis Tool) website. At the top, there are logos for NOAA and the National Weather Service, followed by the text "LCAT Local Climate Analysis Tool". A navigation bar includes links for "Home", "LCAT" (circled in pink), "Learn", "Share", and "Logout" (circled in yellow). A user greeting "Welcome Nicole!" is visible. The main banner features a desert landscape with the text "Learn. Do. Share." in a blue box. Below the banner, there are three columns: "Learn" (with a list of bullet points and a note about scientific guidance), "Do" (with a link to "Local Climate Studies" circled in pink), and "Share" (with instructions on uploading results and searching for studies). A circular logo for the National Weather Service is in the bottom left corner.

LCAT
Local Climate Analysis Tool

Welcome Nicole!

Home LCAT Learn Share Logout

Learn. Do. Share

Use The National Weather Service's Local Climate Analysis Tool (LCAT) To Help You:

- Guide development of your answers to climate-related questions
- Understand your local climate variability and its impacts
- Know your local climate trends in the context of global climate change
- Link weather and water events to climate signals
- Provide your users with trusted scientific information

Please note that LCAT provides scientific guidance but not operational climate forecasts

Learn

LCAT Utility

Available Data Sets

- Sites, Areas, Grids, Teleconnection

Scientifically-sound methods for study

- Climate Variability, Climate Change

Recommended LCAT applications

Do

Local Climate Studies

Correlation Studies

Share

Upload your results for review and publication

Search available studies in your interest

Exchange innovation ideas with your peers

LCAT ANALYSIS OPTIONS

Climate Change Analysis

- How is the climate changing over time?
- Is the climate change signal greater than the climate variability?
- Is there a trend in the data?

Climate Variability Analysis

- Is there a statistically significant relationship with large scale climate patterns?
 - ENSO, AO, NAO, PDA

Use Climate Change Analysis to adjust for trend for Climate Variability Analysis!

Climate Impacts

Data: ?


Data Set: Homogenized Station Data ▾

Variable: Average Temperature ▾

Location: ?

COOP Station ID:

Type location name or ID.

 Select via reference map

Time Frame: ?

Period: Monthly ▾

Month(s): January ▾

Year(s):

1925 | 2015

1925 ▾ 2015 ▾

Add Climate Change Analysis ☒

Add Climate Variability Analysis ☐

Analyze



CLIMATE CHANGE ANALYSIS – QUICK REVIEW

- **Hinge trend** method helps to understand the **current rate of climate change**
- Other methods (**OCN, EWMA**) help you to analyze how climate **normals are changing** over time
- To look at Climate Change (CC) in the context of Climate Variability (CV) you can use a simple ratio of the annual rate of change and Hinge RMSE (Beta = ROC/RMSE with units of “per year”)
- This ratio helps assess the magnitude of CC impacts in the context of CV – how does CC compare to CV?
- A ratio of Beta = 0.05 per year is a big deal (meaning CC is overwhelming CV)
- Values closer to zero show that CV is so large, that the CC is within the context/magnitude of CV, and therefore, less concerning.
- $1/\text{Beta} = 1/0.05 = 20$ years is a big deal (meaning CC is overwhelming CV)
 - This means we are warming at a rate that gets us to a point 20 years faster than natural variability would have warmed us on its own.
- The bigger the CV or the smaller the ROC, the less obvious the CC impact.

$$CC > CV \text{ when } \frac{\text{Annual Rate of Change}}{\text{Hinge Trend RMSE}} \geq 0.05$$

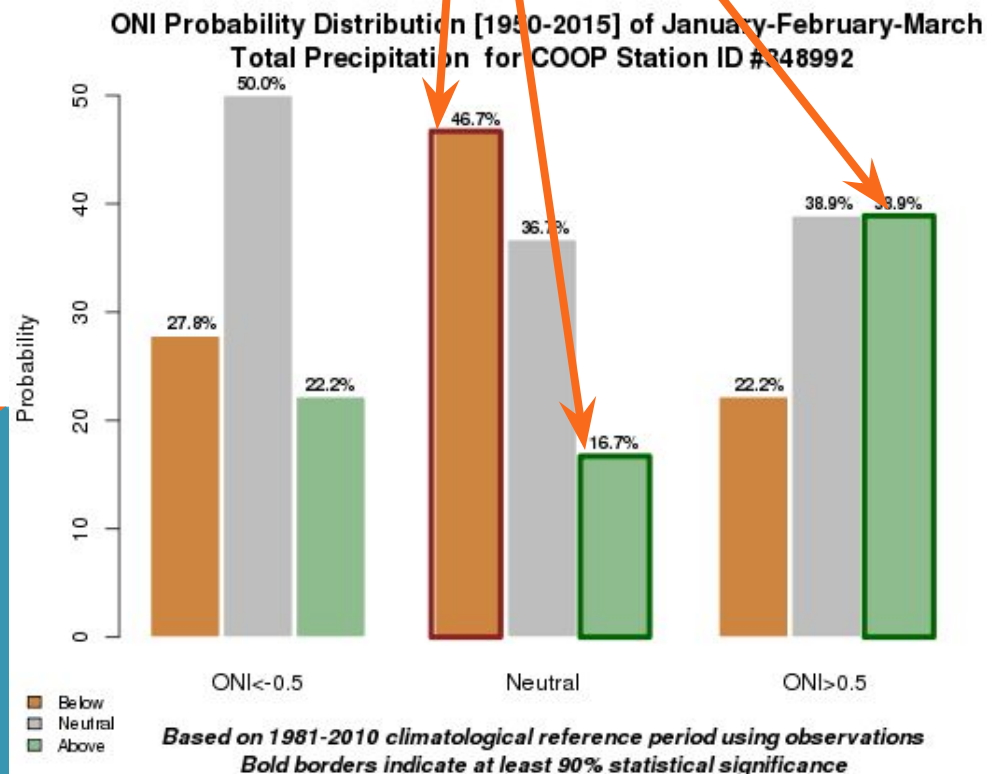
$$CC > CV \text{ when } \frac{1}{\text{Beta}} \leq 20 \text{ years}$$



CLIMATE VARIABILITY ANALYSIS – QUICK REVIEW

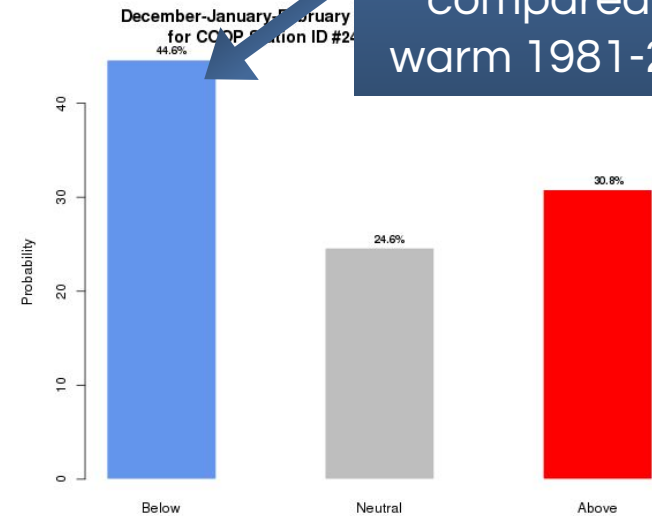
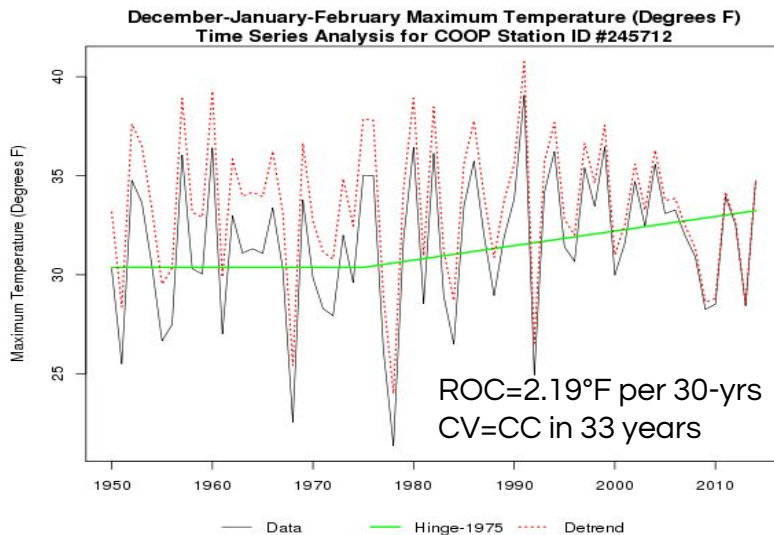
Composite Analysis

- Shows 90% confidence with **bold** borders
- During El Nino events, we can say with 90% confidence, there is an increased chance (tilt in odds) the rainfall will be above normal.
- During ENSO Neutral, we can say with 90% confidence, there is an increased chance (tilt in odds) the rainfall will be below normal and a decreased chance the rainfall will be above normal.



ACCOUNTING FOR TREND

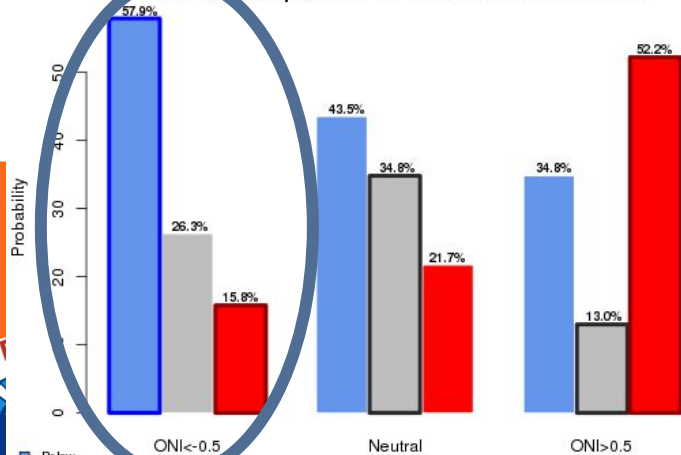
many Below Normal years compared to warm 1981-2010



Based on 1981-2010 Climatological Reference Period

Trend is NOT Adjusted

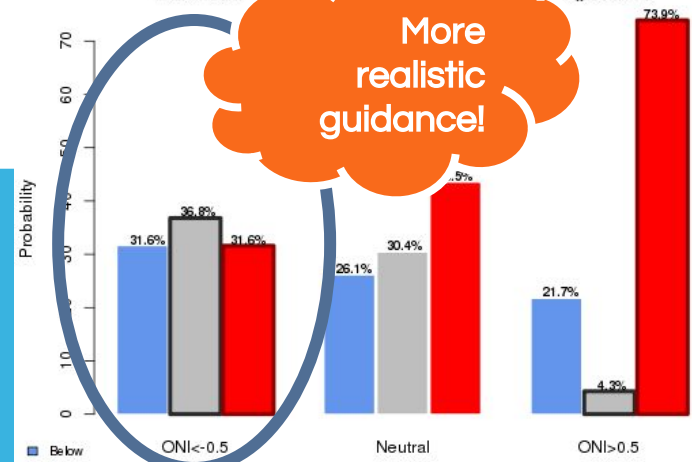
ONI Probability Distribution [1950-2014] of December-January-February Maximum Temperature for COOP Station ID #245712



Based on 1981-2010 climatological reference period using observations
Bold borders indicate at least 90% statistical significance

Trend is Adjusted

ONI Probability Distribution [1950-2014] of December-January-February Maximum Temperature for COOP Station ID #245712



Based on 1981-2010 climatological reference period using Hinge adjusted data
Bold borders indicate at least 90% statistical significance

LCAT Demo



CLIMATE QUESTIONS?

Is climate change making drought more frequent in southwest Oklahoma? Does ENSO play a role in drought conditions?

Altus Lake 2004



U.S. Drought Monitor
Oklahoma

September 13, 2011
(Released Thursday, Sep. 15, 2011)
Valid 7 a.m. EST

| | None | D0-D4 | D1-D4 | D2-D4 | D3-D4 | D4 |
|------------------------------------|-------|--------|--------|--------|-------|-------|
| Current | 0.00 | 100.00 | 100.00 | 100.00 | 92.59 | 68.93 |
| Last Week 8/26/2011 | 0.00 | 100.00 | 100.00 | 100.00 | 85.44 | 69.15 |
| 3 Months Ago 6/14/2011 | 22.11 | 77.89 | 57.67 | 41.76 | 33.53 | 10.32 |
| Start of Calendar Year 1/1/2011 | 8.01 | 91.19 | 12.53 | 1.05 | 0.00 | 0.00 |
| Start of Water Year 9/24/10/10 | 66.29 | 33.72 | 4.21 | 0.00 | 0.00 | 0.00 |
| One Year Ago 9/14/10/10 | 50.13 | 49.87 | 7.72 | 0.00 | 0.00 | 0.00 |

Intensity:
 D0 Abnormally Dry
 D1 Moderate Drought
 D2 Severe Drought
 D3 Extreme Drought
 D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author:
Mark Svoboda
National Drought Mitigation Center

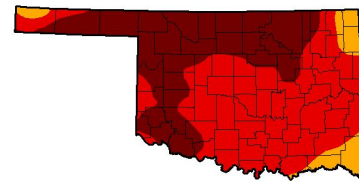


<http://droughtmonitor.unl.edu/>

U.S. Drought Monitor
Oklahoma

January 29, 2013
(Released Thursday, Jan. 31, 2013)
Valid 7 a.m. EST

| | None | D0-D4 | D1-D4 | D2-D4 | D3-D4 | D4 |
|------------------------------------|------|--------|--------|--------|-------|-------|
| Current | 0.00 | 100.00 | 100.00 | 100.00 | 92.14 | 39.58 |
| Last Week 1/22/2013 | 0.00 | 100.00 | 100.00 | 100.00 | 91.80 | 39.58 |
| 3 Months Ago 10/30/2012 | 0.00 | 100.00 | 100.00 | 99.43 | 67.64 | 27.13 |
| Start of Calendar Year 1/1/2013 | 0.00 | 100.00 | 100.00 | 100.00 | 94.88 | 17.06 |



U.S. Drought Monitor
Oklahoma

April 8, 2014
(Released Thursday, Apr. 10, 2014)
Valid 8 a.m. EDT

| | None | D0-D4 | D1-D4 | D2-D4 | D3-D4 | D4 |
|------------------------------------|-------|-------|-------|-------|-------|-------|
| Current | 6.34 | 93.66 | 76.48 | 52.63 | 26.39 | 13.00 |
| Last Week 4/1/2014 | 4.05 | 95.95 | 77.48 | 50.67 | 24.03 | 8.00 |
| 3 Months Ago 1/10/2014 | 50.84 | 49.16 | 38.17 | 16.99 | 4.84 | 2.00 |
| Start of Calendar Year 1/1/2014 | 50.84 | 49.16 | 38.17 | 16.99 | 4.84 | 2.00 |
| Start of Water Year 3/1/2013 | 21.74 | 78.26 | 43.00 | 17.62 | 4.42 | 1.00 |
| One Year Ago 4/8/2013 | 0.70 | 99.30 | 95.01 | 91.00 | 36.44 | 8.00 |

Intensity:
 D0 Abnormally Dry
 D1 Moderate Drought
 D2 Severe Drought
 D3 Extreme Drought
 D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author:
Brian Fuchs
National Drought Mitigation Center



<http://droughtmonitor.unl.edu/>



Is climate change making drought more frequent in southwest Oklahoma?

1) Select Data

2) Select Location

5) Select Time Frame
(double check before clicking Analyze)

3) Turn "ON" CC Analysis

4) Make Trend selections

Climate Impacts

Data: ?

Data Set:

Variable:

Location: ?

NCDC Climate Division:

 [Select via reference map](#)

Time Frame: ?

Period:

Month(s):

Year(s):

Add Climate Change Analysis



Trend: ?

Add Trends: Data trending enabled.

Please select one or more options above
(by holding the shift or control key) to access the following choices

Time Series Analysis Type:

☐ Ensemble

☒ Rate of Change

☐ Detrend

Add Climate Variability Analysis



Is CC > CV?

$$\frac{\text{Annual Rate of Change}}{\text{Hinge Trend RMSE}} \geq 0.05?$$

$$\text{or } \frac{1}{\text{Beta}} \leq 20 \text{ years?}$$

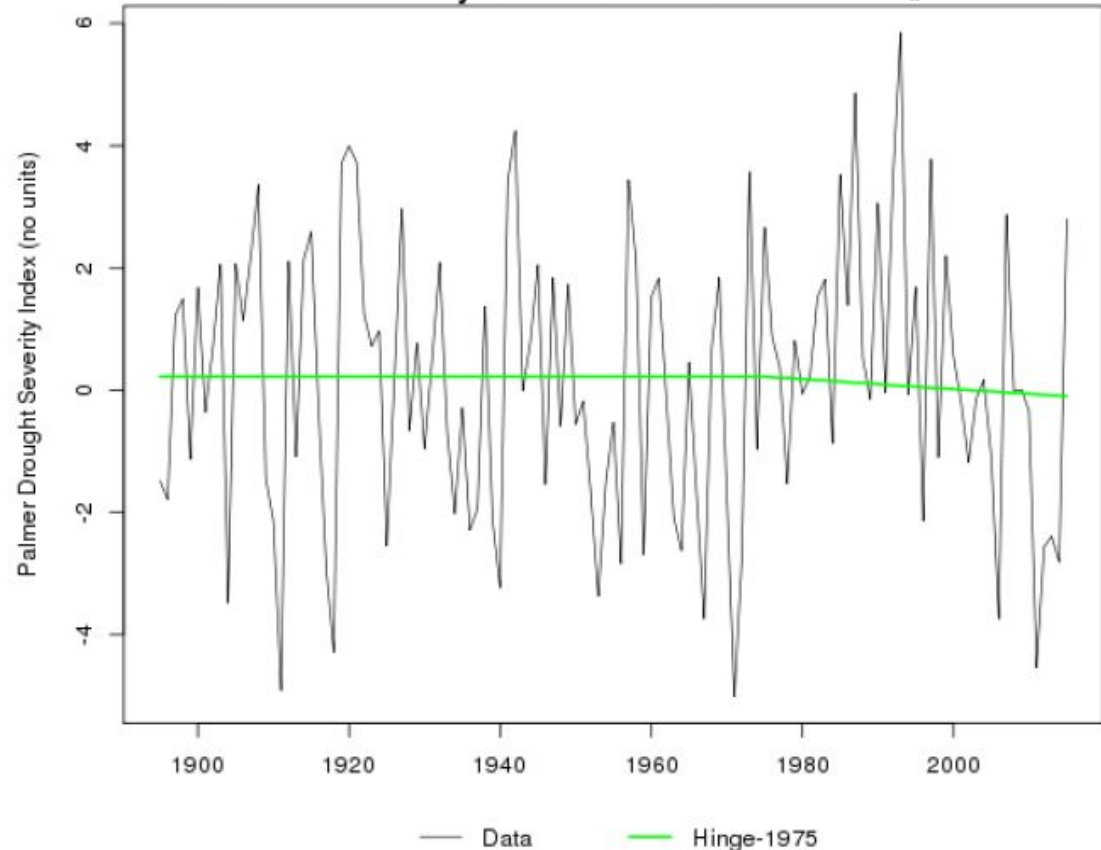
$$\frac{-0.008}{2.20} = -0.003$$

$$\text{or } \frac{1}{-0.003} = -333 \text{ years}$$

- * The Climate Change signal is well within the range of natural variability (noise).
- * There is virtually no recent trend (post 1975) or long-term trend in the Palmer Drought Severity Index during AMJ.

| Data | Statistics |
|--------------------|------------|
| Mean | 0.02 |
| Median | -0.07 |
| Mode | -3.74 |
| Minimum | -5.01 |
| Maximum | 5.85 |
| Standard Deviation | 2.316 |
| Skewness | 0.154 |
| Kurtosis | -0.414 |

April-May-June Palmer Drought Severity Index (no units)
Time Series Analysis for NCDC Climate Division ID #OK07



Rate of Change

| | |
|-------------|-----------------------------------|
| Annual_ROC | -0.008 No units per year |
| Decadal_ROC | -0.08 No units per decade |
| Climo_ROC | -0.24 No units per 30-year period |

Trend Performance

Root Mean Square Error

| | |
|-------------|---------------|
| Hinge-1975: | 2.20 No_units |
|-------------|---------------|

Does ENSO play a role in drought conditions in southwest Oklahoma?

1) Check on "Detrend"
(Verify the Trend type)

2) Turn "ON" Climate Variability Analysis
Double check Time Frame above!

3) Select Index & parameters

4) Select Analysis Display Types

5) Select Data Binning/Thresholds

Add Climate Change Analysis ☒

Trend: ?

Add Trends: Data trending enabled.

EWMA (15yr)
Hinge (1975)
OCN (11yr)
OCN (15yr)

Clear

Please select one or more options above
(by holding the shift or control key) to access the following choices

Time Series Analysis Type:

☐ Ensemble

☒ Rate of Change

☒ Detrend

Add Climate Variability Analysis ☒

Signal: ?

Index:
Oceanic Niño Index (ONI)

Phases: Negative/Neutral/Positive

Thresholds: Critical Value (Degrees C)

When ONI is the selected signal index, only -0.5 and 0.5 are allowable threshold values.

-2 -0.5 0.5 2

Analysis Type: ?

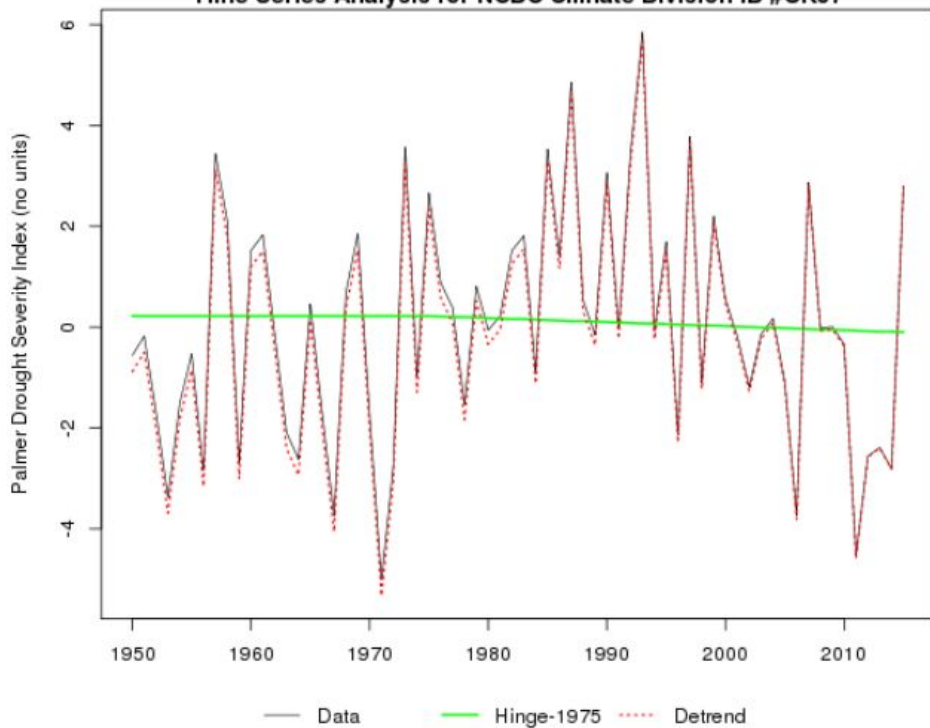
Display:
Local ENSO Impacts (composites)
Departure from Normal
Boxplot

Data Binning: 2-Category

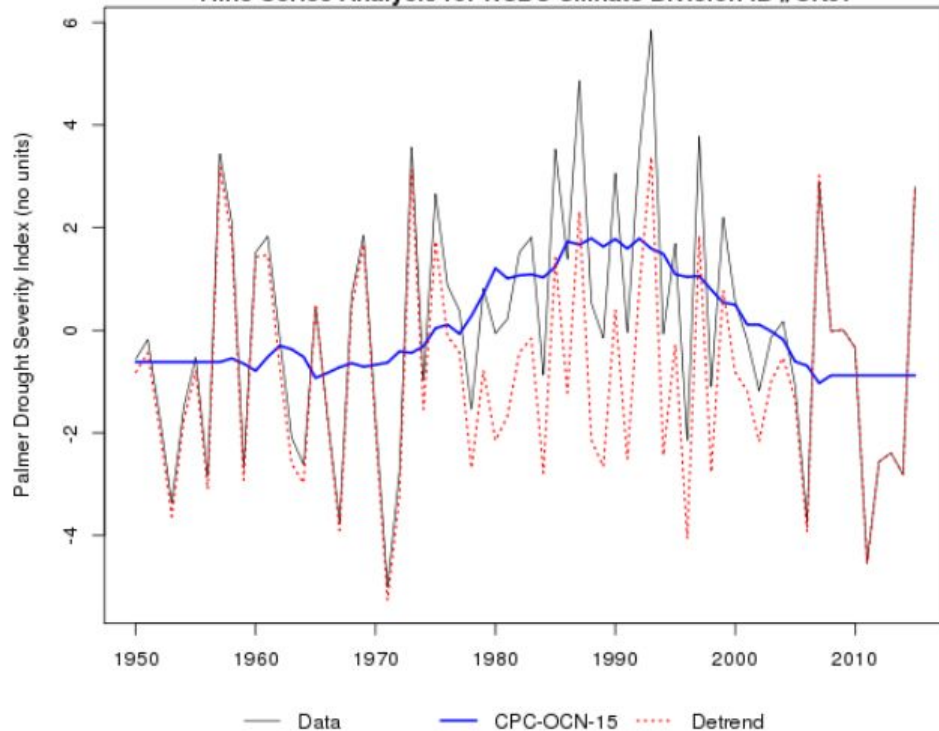
Thresholds: Climatological Median



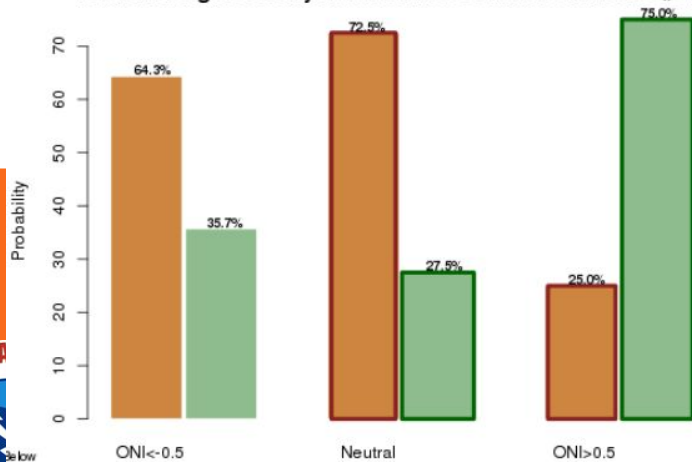
April-May-June Palmer Drought Severity Index (no units)
Time Series Analysis for NCDC Climate Division ID #OK07



April-May-June Palmer Drought Severity Index (no units)
Time Series Analysis for NCDC Climate Division ID #OK07

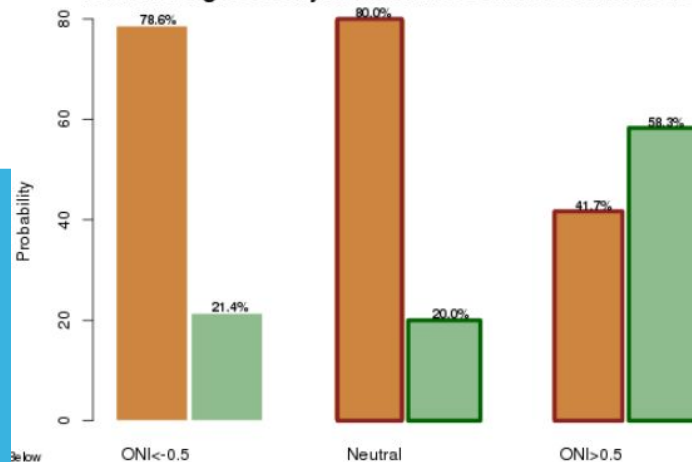


ONI Probability Distribution [1950-2015] of April-May-June
Palmer Drought Severity Index for NCDC Climate Division ID #OK07



Based on 1981-2010 climatological reference period using Hinge adjusted data
Bold borders indicate at least 90% statistical significance

ONI Probability Distribution [1950-2015] of April-May-June
Palmer Drought Severity Index for NCDC Climate Division ID #OK07



Based on 1981-2010 climatological reference period using OCN-15 adjusted data
Bold borders indicate at least 90% statistical significance

Using 1981-2010 Median for the binning threshold:

| Signal Data | Number of Events | Below Bin ≤ 0.20 | | Above Bin > 0.20 | |
|--------------|------------------|-----------------------|--------------|--------------------|--------------|
| | | % Chance | Significance | % Chance | Significance |
| ONI < -0.5 | 14 | 64.3% | 76.0% | 35.7% | 76.0% |
| ONI Neutral | 40 | 72.5% | 97.9% | 27.5% | 97.9% |
| ONI > 0.5 | 12 | 25.0% | 99.6% | 75.0% | 99.6% |
| Total Years | 66 | | | | |

- The PDSI is calculated based on precipitation and temperature data, as well as the local Available Water Content (AWC) of the soil. It is standardized.
- From the inputs, all the basic terms of the water balance equation can be determined, including evapotranspiration, soil recharge, runoff, and moisture loss from the surface layer.
- Human impacts on the water balance, such as irrigation, are not considered.

| PDSI Value | Descriptor |
|----------------|-----------------------|
| > 4.00 | Extreme Moist Spell |
| 3.0 to 3.99 | Very Moist Spell |
| 2.0 to 2.99 | Unusual Moist Spell |
| 1.0 to 1.99 | Moist Spell |
| 0.50 to 0.99 | Incipient Moist Spell |
| ----- | |
| -0.49 to 0.49 | Near Normal |
| -0.50 to -0.99 | Incipient Drought |
| -1.00 to -1.99 | Mild Drought |
| -2.00 to -2.99 | Moderate Drought |
| -3.00 to -3.99 | Severe Drought |
| < -4.00 | Extreme Drought |



Using 1981-2010 Mean for the binning threshold:

| Signal Data | Number of Events | Below Bin ≤ 0.88 | | Above Bin > 0.88 | |
|--------------|------------------|-----------------------|--------------|--------------------|--------------|
| | | % Chance | Significance | % Chance | Significance |
| ONI < -0.5 | 14 | 78.6% | 80.4% | 21.4% | 80.4% |
| ONI Neutral | 40 | 80.0% | 98.2% | 20.0% | 98.2% |
| ONI > 0.5 | 12 | 25.0% | 99.9% | 75.0% | 99.9% |
| Total Years | 66 | | | | |

* Binning threshold could be far away from Zero

- For PDSI, the brown shading may contain moist spell values!

* Always check the actual data and don't rely solely on the graphs!

| PDSI Value | Descriptor |
|----------------|-----------------------|
| > 4.00 | Extreme Moist Spell |
| 3.0 to 3.99 | Very Moist Spell |
| 2.0 to 2.99 | Unusual Moist Spell |
| 1.0 to 1.99 | Moist Spell |
| 0.50 to 0.99 | Incipient Moist Spell |
| -0.49 to 0.49 | Near Normal |
| -0.50 to -0.99 | Incipient Drought |
| -1.00 to -1.99 | Mild Drought |
| -2.00 to -2.99 | Moderate Drought |
| -3.00 to -3.99 | Severe Drought |
| < -4.00 | Extreme Drought |



CLIMATE QUESTIONS?

Is climate change making drought more frequent in southwest Oklahoma?

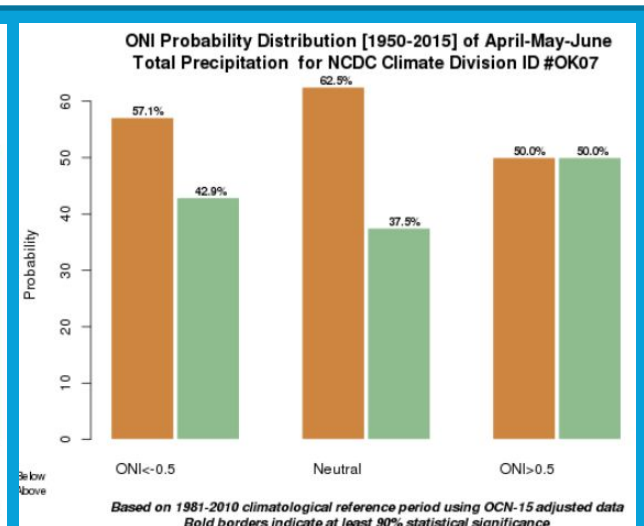
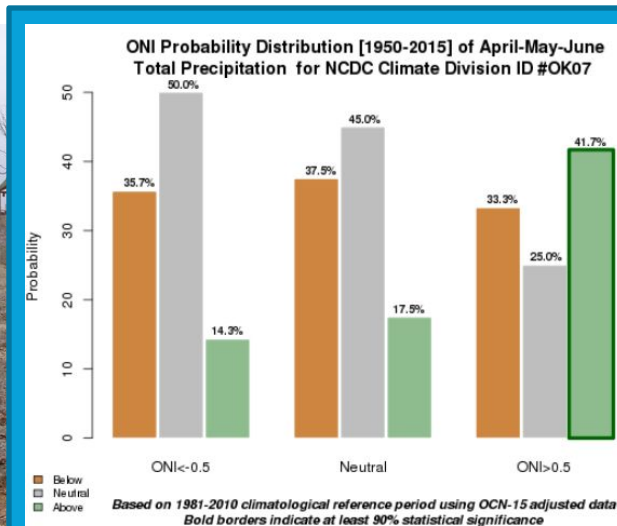
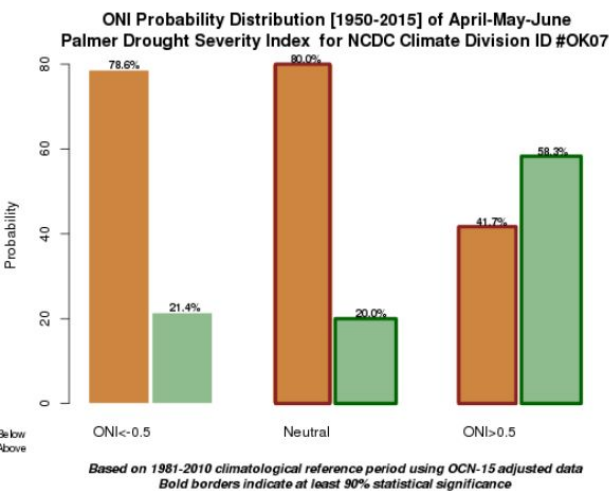
No. The Climate Change signal for the Palmer Drought Severity Index is within the range of natural variability in April-May-June.

There is virtually no recent trend (post 1975) or long-term trend in the Palmer Drought Severity Index during April-May-June.

Does ENSO play a role in drought conditions?

Yes. During El Niño events, we can say with 90% confidence, there is an increased chance (tilt in odds) for moist spells and a decreased chance for drought conditions in April-May-June.

During ENSO neutral times, we can say with 90% confidence, there is an increased chance (tilt in odds) for drought conditions and a decreased chance for moist spells in April-May-June.



LOCAL CLIMATE ANALYSIS TOOL

LCAT DEMO



Questions?

National Climate Services Meeting
May 9-12, 2016

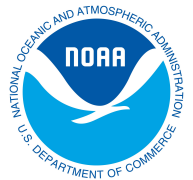


NCEI Climate at a Glance (CAG): *Primer*

Deke Arndt
NOAA's National Centers for Environmental Information

May 2016 NWS Climate Services Get Together

NOAA Satellite and Information Service | National Centers for Environmental Information





CAG: <https://www.ncdc.noaa.gov/cag>

- CAG is one of several basic tools developed during NCEI's ~70 years of climate services experience
- It fits the model of most successful “eyeball to eyeball” climate services:
 - Relatively simple tool; relatively complex usage;
- This week, AMS will develop an app that uses CAG data to teach advanced statistics
 - This was not an original “requirement”, but results from building tools to meet requirements



CAG “requirements”

- Service four of the five ligaments of climate monitoring:
 - **Observation**: what was observed
 - **Departure**: how different is that from a base period
 - **Unusualness**: how unusual is that difference
 - **Trend**: is this part of a bigger picture?
- It doesn't service the most expensive monitoring facet:
 - **Impact**: what did it cost (property, [quality of] life)

Climate at a Glance (CAG)

NOAA NATIONAL CENTERS FOR ENVIRONMENTAL INFORMATION
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Home Climate Information Data Access Customer Support Contact About Search

Home > Climate Monitoring > Climate at a Glance April Global Release: Wed, 18 May 2016, 11:00 AM EDT

Climate at a Glance

Climate Monitoring
State of the Climate
Temp, Precip, and Drought
Climate at a Glance
Extremes
Societal Impacts
Snow and Ice
Teleconnections
GHCN Monthly
Monitoring References

Time Series | Mapping | Data Information | Background

NCEI added Alaska climate divisions to its nClimDiv dataset on Friday, March 6, 2015, coincident with the release of the February 2015 monthly monitoring report. For more information on Alaska climate data, please visit the Alaska Climate Divisions FAQ.

Time Series

U.S. Globe

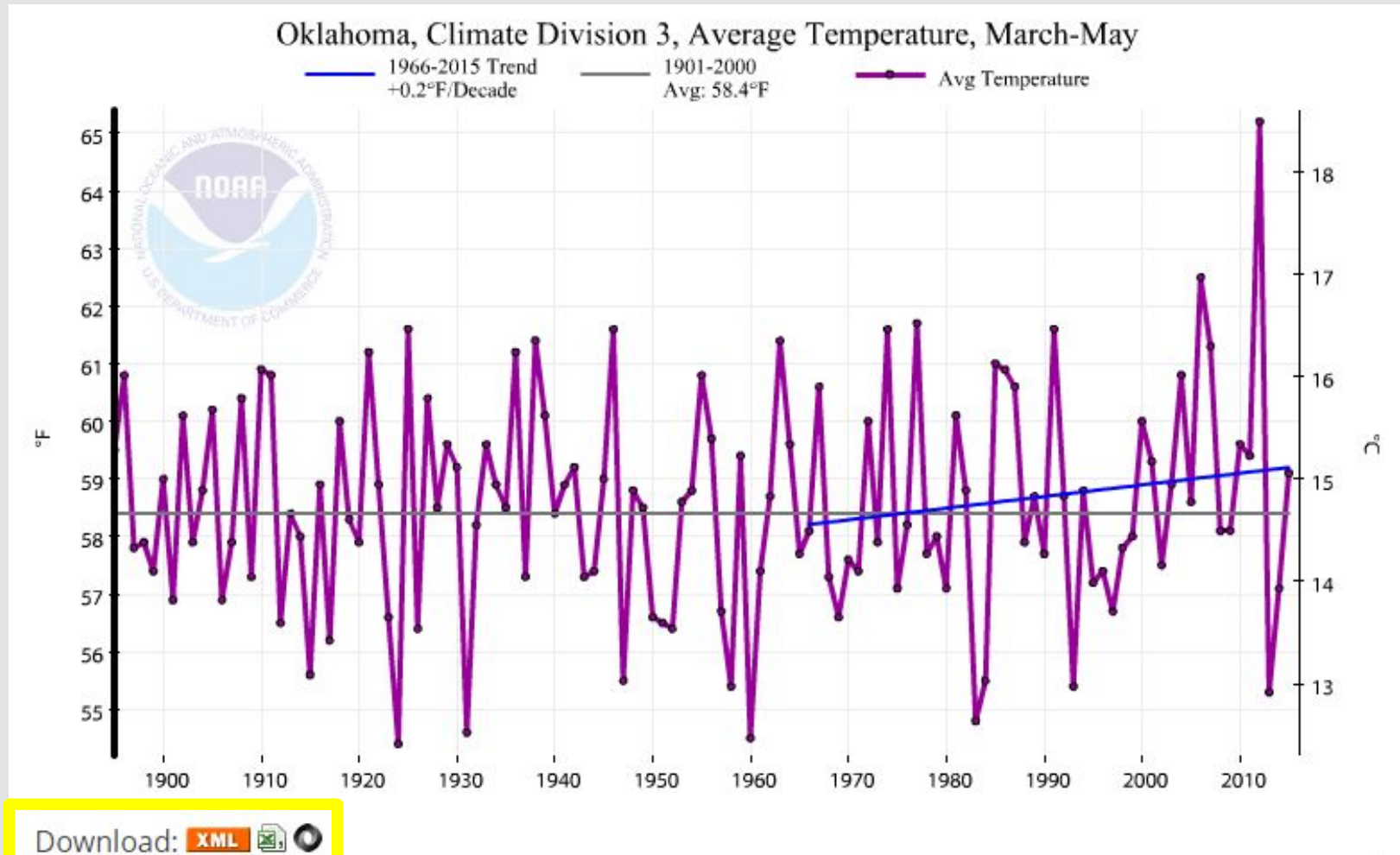
Choose from the options below and click "Plot" to create a time series graph.
Please note, Degree Days are not available for Agricultural Belts, NWS Regions, Alaska and Cities; Palmer Indices are not available for NWS Regions, Alaska and Cities.

Parameter: Average Temperature
Time Scale: 3-Month
Month: May
Start Year: 1895

Options

☒ Display Base Period
Start: 1901 End: 2000
☒ Display Trend

CAG Timeseries



☒ Climate at a Glance

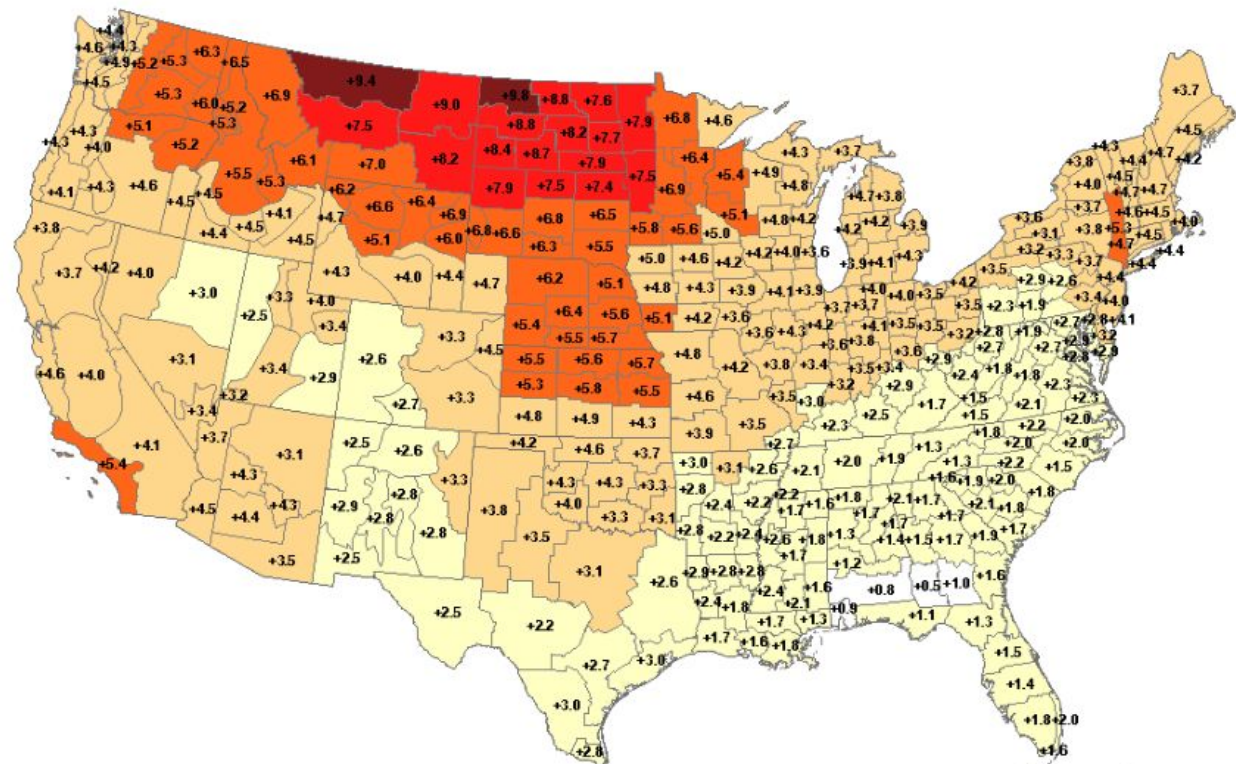
Divisional

Temperature Avg ▼

Anomalies ▼

☒ Pick a date range (up to 1 year)

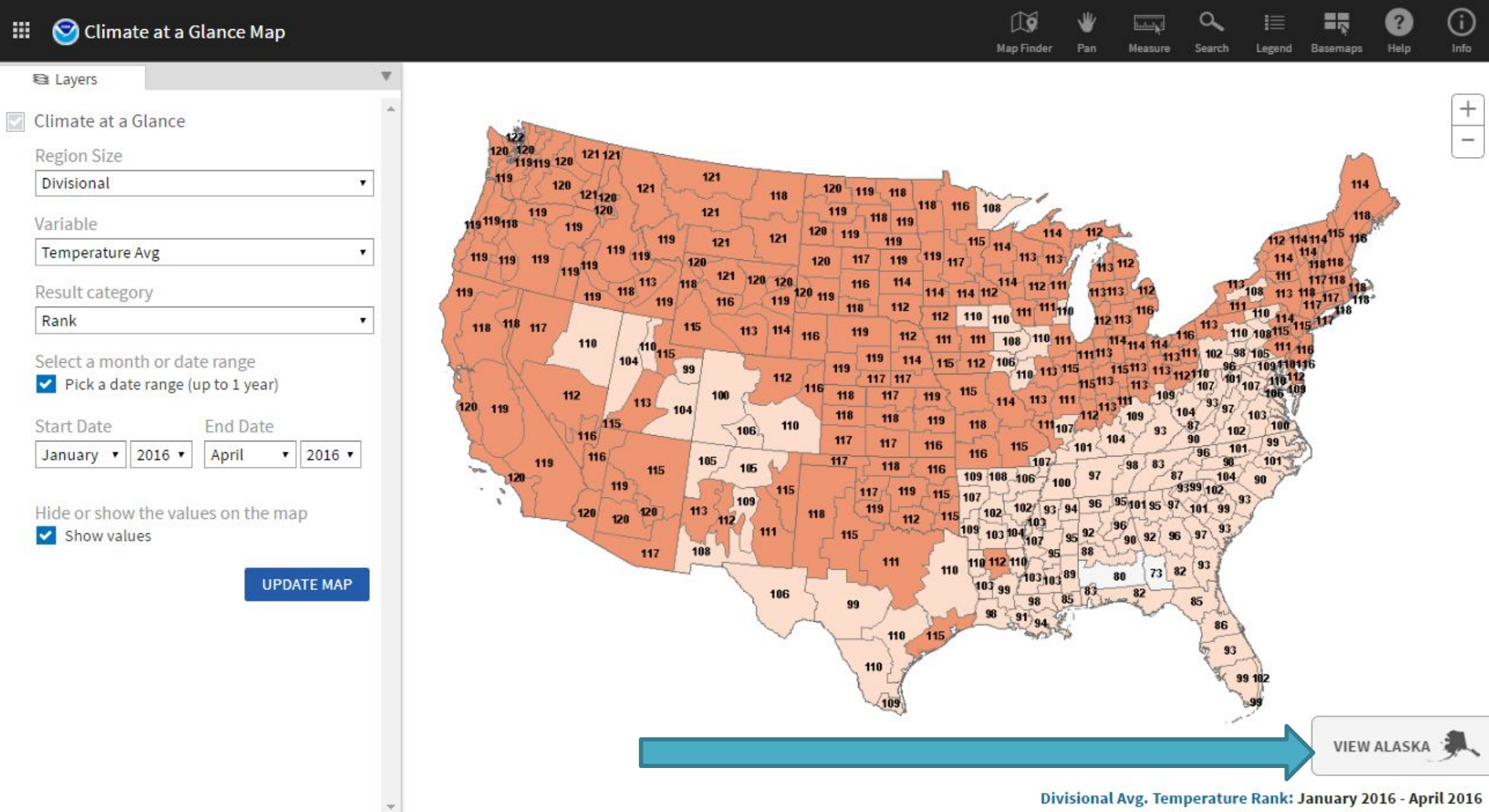
January 2016 April 2016

☒ Show valuesVIEW ALASKA 

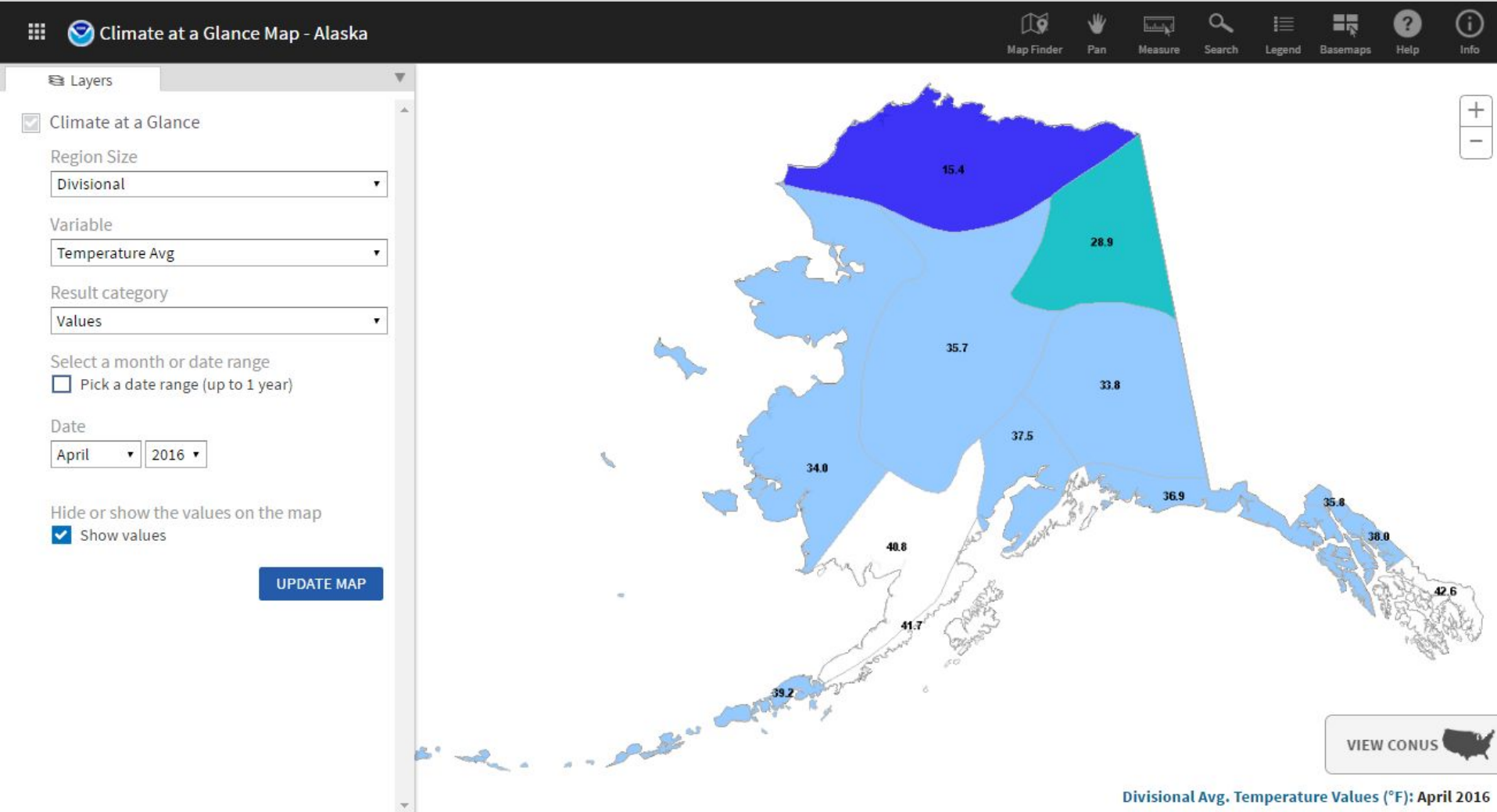
Divisional Avg. Temperature Anomalies (°F from 1901-2000 mean): January 2016 - April 2016



CAG Mapping



CAG Mapping



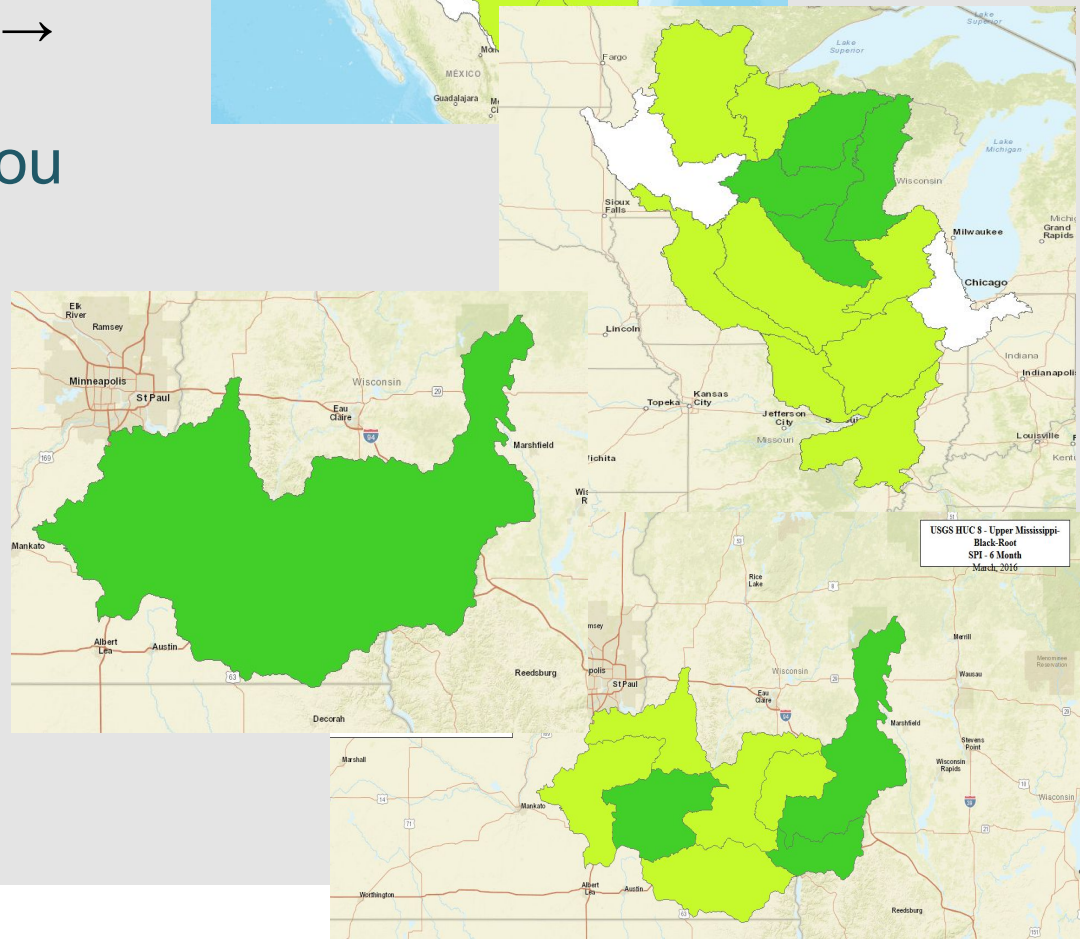
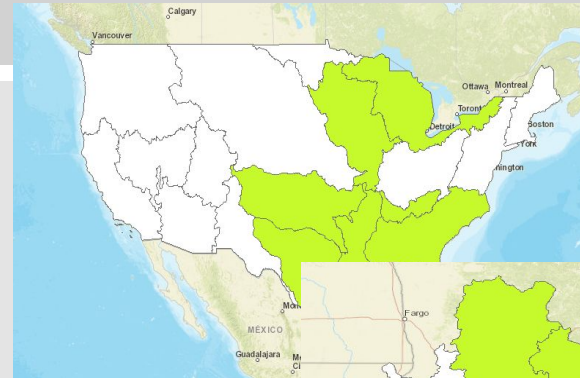


CAG: <https://www.ncdc.noaa.gov/cag>

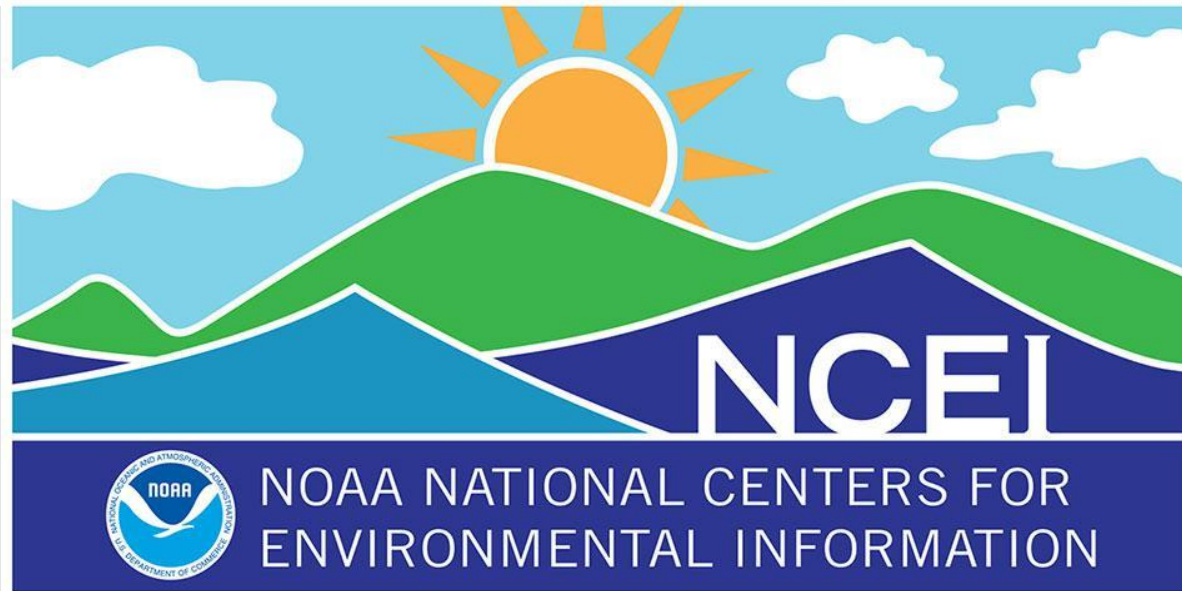
- **Time series** and **Mapping** gotchas:
 - Multi-month “seasons” constructed like so:
 - “Summer” (JJA) is “the 3-month period ending in August”
- Cities are different than shapes
- OCONUS is different than CONUS
 - Periods of record
 - Number of derived indices available
- Shapes are typically better at describing climate behavior, unless you’re absolutely married to the station, or you want to capture the range of variability at a place.

Building on CAG “requirements”

- Traditional spatial scales:
 - Stations → climate divisions
 - states → climate regions → National
- Being added now (thank you to NCEI colleagues):
 - HUCs
 - Counties
 - Zip Codes
- Recently expressed as “requests”
 - CWAs
 - RFC footprints



USGS HUC 8 - Upper Mississippi-
Black-Rock
SPI 4 Month
March 2006



Deke Arndt
Derek.Arndt@noaa.gov
www.ncei.noaa.gov
www.climate.gov



NCEI Climate Facebook: <http://www.facebook.com/NOAANCElclimate>

NCEI Ocean & Geophysics Facebook: <http://www.facebook.com/NOAANCEloceangeo>

NCEI Climate Twitter (@NOAANCElclimate): <http://www.twitter.com/NOAANCElclimate>

NCEI Ocean & Geophysics Twitter (@NOAANCElocngeo): <http://www.twitter.com/NOAANCElocngeo>

